TRIP REPORT
Three Rivers, Libby, and Fortine Ranger Districts
October 22-28, 1998

As the 1998 field season progressed, and the effects of the Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopkins) flight began to be realized, we became aware of unusually high beetle populations in many Douglas-fir and mixed-species conifer stands throughout northwest Montana and northern Idaho. As a result, we have received numerous requests for assistance in evaluating current-year effects, making some estimates of future beetle-caused mortality, and helping develop reasonable management alternatives. In many of the areas evaluated, we came to realize that Douglas-fir beetle-caused tree mortality was only the current manifestation of an underlying and associated high level of root diseases and their deleterious effects on beetle hosts. In fact, it is the presence of root diseases, in many of the Douglas-fir forest types, which result in "high endemic" levels of beetles, and the propensity for rapid beetle population build ups when favorable conditions present themselves.

We believe that is a major factor contributing to unusually high beetle populations at the present time; however, the "trigger" for this series of outbreaks appears to be weather-related. Storm-caused damage from winter 1996-97--snow breakage, wind throw, ice damage, etc.--created ideal conditions for beetles in spring 1997. Not only did beetles infest downed material in high numbers, nearby standing trees may also have been infested. Mild temperatures during that winter and the succeeding one facilitated beetle survival, aiding rapid population increases. "Fading" trees from the past 2 years (hot, dry conditions in mid-summer resulted in some trees attacked earliest in 1998 to begin fading by late summer) greatly increased our awareness of beetle-caused tree mortality in many areas. Subsequent ground surveys showed many more trees were infested in 1998 than had been in 1997--most of which will not become apparent until 1999. Data collected in northern Idaho and western Montana over the past 2 months suggest 1998 may have been the "peak" year for these outbreaks, with 1998-attacked trees outnumbering 1997 attacks by about 4-7 times in some areas. Barring unusually dry weather in 1999, we expect beetle populations to decline; though to reiterate, more faded trees will be apparent in 1999 than in 1998. Additional tree killing, at a declining rate, will likely continue for another year or so.

In some cases, root disease presence was known or suspected. In others, it was only realized as stand conditions were assessed relative to bark-beetle-caused mortality. In either case, it seemed appropriate to have both an entomologist and a pathologist address conditions and recommendations. As a result, we coordinated our efforts where possible, on several service visits to the Kootenai NF during latter October.

On October 22, Ken accompanied Steve Prieve, Russ Gautreaux, Steve Straley, Dave Dorman, Kris Newgard, and Shane Jones as they walked over portions of Stanley Mountain, a portion of the Spar Planning Unit. On October 28, Blakey and Ken went back to that area with Russ and Steve (Straley) to go over the area more thoroughly.

On October 23, Ken met with Gary Dickerson, Deena Shotzberger, Anne Weber, Bruce Higgins and Ann Odor. Together they walked or drove through several beetle-infested areas on the Libby RD.

Finally, on October 27, Blakey and Ken met first with Rob Carlin, Coleen Dunham, Pat Flanary and Scott Bates as they assessed a portion of the Meadow Creek timber sale area (stands 30-2-38 and 30-2-39) above Pinkham Creek. That afternoon, they accompanied Scott on a review of conditions in a stand (#58-1-118) in the "Burma" sale area, northeast of Eureka.
For the purposes of this report, we will describe the areas and conditions in each, specifically. Expectations and recommendations will be of a more general nature, but will be related to an area where it seems appropriate.

Stanley Mountain, Spar Planning Unit, Three Rivers RD--"Stanley Mountain" sale area is an 800-acre, west-facing slope of Stanley Mountain above Stanley Creek and west of Bull Lake. Stanley Creek flows directly into Bull Lake. The 800-acre sale area is a mixed-conifer stand, but comprised of about 90% Douglas-fir and lesser amounts of western larch, ponderosa pine, grand fir, western redcedar, western hemlock and lodgepole pine. Most of the stand is in the 100- to 120-year age class, with occasional individuals--Douglas-fir, western larch and ponderosa pine--exceeding 250 years. Scattered across the hillside are groups of fading Douglas-fir killed by Douglas-fir beetles within the past 1-3 years, ranging in size from 3-5 trees to 25-30 trees each. Other "groups" contain trees which have been dead for many years and appear as more typical "root disease centers."

In walking through much of the area, we found many Douglas-fir which have been attacked by Douglas-fir beetles this year, and have not yet begun to fade. Many more red-orange trees will be visible on the hillside next year than are noticeable now. In addition we found evidence that root diseases--especially armillaria root disease (*Armillaria ostoyae* (Romagn. Herink) and brown cubical root and butt rot (*Phaeolus schweinitzii* (Fr.) Pat.) --are prevalent throughout the area. The brown cubical root and butt rot is the primary agent in the more intact part of the area, where grand fir is mixed with Douglas-fir. In these portions, fir engraver (*Scolytus ventralis* LeConte) has been attacking an occasional grand fir, while Douglas-fir beetle has been working on the Douglas-fir. Armillaria root disease is the primary agent in those areas where obvious root disease patches have been developing in the stand for quite some time. There is evidence of Armillaria in the more intact portions, but it is just beginning to manifest itself. Numerous pit and mounds can be found throughout the stand, especially in the upper portion near the ridge. The soils on the steeper sections seem to be very rocky and shallow. These two pieces of evidence (pit/mounds and shallow soils) may be indicative of unstable soil conditions, and should be considered with any management proposed for the area.

It seems likely that, without some action to reduce mortality to beetles and restore some of the root disease-affected areas to less-susceptible species, Douglas-fir mortality will continue at an increasing rate for the next few years. Unless some weather event--unusually cold and wet conditions--occurs, it is quite probable that most of the Douglas-fir greater than 14-16 inches will be killed by Douglas-fir beetle.

Sanitation/salvage logging, on the other hand, could capture dead volume before its economic value is lost, could reduce the amount of beetle pressure on the stand, and could significantly reduce threats to remaining green, less-susceptible Douglas-fir. By concentrating on existing groups of beetle-killed trees and/or root disease patches, regenerating small 3- to 5-acre patches with a tree species such as western larch and ponderosa pine--ones more resistant to root pathogens--could be favored. Such actions would do much, in a relatively short period of time, to restore diversity and stability to what is now an ecosystem declining in health and viability. However, management acitivites which involve intermediate harvesting, such as a commercial thin, will very likely trigger a response from the root disease. Stumps created during harvest activities become a ready food supply for the root disease fungi, which in turn move from the stumps to the neighboring standing trees. Permanent plots have documented an increase in mortality, by volume, from commercial thinning in Douglas-fir.

Relative to watershed health, it is important to realize that under the "no action alternative" this hillside will continue to change due to the activity of root disease and bark beetles. The overall canopy closure will continue to decline, which will in turn affect such things as hydrologic recovery within the watershed. An analysis done on the Coeur d'Alene River Basin looked at the effect of canopy reduction from root disease on the hydrologic recovery of the forested lands within the basin (Hagle et al. 1994). It was determined that severe root disease could reduce future canopy closure by as much as 35% in certain habitat types.

Libby Ranger District--In many parts of the District, and notably areas affected by fires of 1994, Douglas-fir beetle populations are at epidemic levels. Especially on the "sheep range," a portion of which was

affected by the China Basin Fire, a significant portion of the Douglas-fir over about 14 inches have been killed. That infestation, a direct result of beetles taking advantage of fire-weakened trees, appears to have peaked. A walk through that area revealed fewer trees attacked in 1998 than in 1997. That would be expected inasmuch as most of the larger trees have been killed within the past 2-3 years. Notes compiled by Bruce indicated that approximately 80% of the Douglas-fir in the 18 and greater inch classes have been killed, and that 30-50% of the 14"-18" diameter class was attacked in 1998. Though prognoses of additional mortality are dependent to a considerable degree upon weather this winter and next spring, if conditions are "normal," it is reasonable to expect additional mortality next year, though at a declining rate due to host depletion.

In other parts of the District visited--near McMillan Mountain, along Koocanusa Reservoir, and south along Hiway 2--observed mortality and beetle populations are at "higher-than-normal" levels in many Douglas-fir stands. Though time did not permit our walking through each area, observations made in many areas throughout the Region this fall suggest it is not uncommon to find 4-8 "green-attacked" trees (attacked in 1998) for each "fader" (trees attacked in 1997). While that average may vary considerably from area to area, it is reasonable to assume that in most areas, beetle populations are sufficiently high to expect additional tree killing in 1999. Unusual weather--extremely cold temperatures accompanied by little snow accumulation this winter, or abnormally wet and cool conditions next spring--could reduce beetle populations significantly. Likewise, sanitation/salvage logging, particularly if it included currently infested trees, could locally reduce some populations. Otherwise, it is conceivable that populations could remain at epidemic levels in a particular area until most of the "high-hazard" trees (those over about 14-16 inches dbh) are killed. As beetles are required to fly long distances to find susceptible hosts, or begin to attack younger, more vigorous trees, their populations will begin to decline. Typically,
Douglas-fir beetle outbreaks do not last more that 2-4 years in a particular area.

Stands 30-2-38 and 30-2-39, Meadow Creek, Fortine RD--This area, above Pinkham Creek, is another where atypically high amounts of beetle-caused mortality are found. There are evidences of root diseases in the area; Armillaria root disease is very active close to the road, and has caused an obvious opening in the canopy due to wood cutters taking out the killed Douglas-firs. Annosum-like root disease is actively infecting the larger roots of the trees in the upper portions of the stand. Positive identification of this pathogen is pending, but will not change the management recommendations made in this report. Scattered, older blowdown suggest beetle populations likely began building to higher-than-normal levels a couple years ago and are now killing green, relatively healthy trees. The scenario observed in many parts of the Region--blowdown from two or three years ago, high overwintering brood survival, and high endemic beetle populations associated with root disease presence--has resulted in increasing amounts of beetle-caused mortality.

As is the case in several of the areas we have observed, here it seems a prudent course of action would be removal of beetle-infested groups in a "group-selection" method of regenerating as much of the area as is practicable. Because of the presence of root disease, favoring or regenerating species less susceptible to root diseases and non-hosts of the beetle, such as western larch and ponderosa pine, would be a reasonable alternative to the preponderance of Douglas-fir which now exists there. Please refer to the Stanley Mountain discussion on root diseases and management in the above section.

Stand 58-1-118, "Burma Area," Fortine RD--Quite similar in many respects to others we had observed in previous trips on the Forest, this stand, adjacent to the Canadian border and east of Eureka, is a 52-acre stand scheduled for shelterwood harvests of 15 and 9 acres each, with a "leave" strip between. Essentially a 2-storied stand with old-growth western larch, ponderosa pine and some Douglas-fir in the overstory; the understory is primarily younger Douglas-fir. The former is older than 250 years (a recently cut larch stump had 495 rings), while the latter ranges from 100-200 years old. Average basal area is 204 square feet per acre, with an estimated 375 trees per acre. Much of the understory Douglas-fir varies from 14"-17" dbh.

Once again, we observed root diseases and current Douglas-fir beetle-caused mortality. We found numerous fruiting bodies of *P. schweinitzii*, the fungus causing brown cubical root and butt rot, throughout the stand. Evidence was also found in the numerous Douglas-fir snap-offs, which had significant amounts of brown cubical decay in the heartwood. Armillaria root disease is also evident in small patches of active mortality. Though beetle populations were not as high as some of the areas we had recently visited, the level of activity suggests continuing mortality could be expected. The anticipated treatment, particularly if conducted within the next year or so, could do much to reduce future losses to beetles. Favoring western larch and ponderosa pine, at the expense of Douglas-fir in the larger diameter classes would significantly reduce beetle risk in the stand, as well as reduce the effect from root disease. Please refer to the Stanley Mountain discussion on root diseases and management in the above section.

General Guidelines and Recommendations

Within the past year, we (FS entomologists in the western Regions and Research) have completed and submitted for publication, a program which can assist in predicting Douglas-fir beetle-caused mortality in highly susceptible stands of Douglas-fir. While the publication will describe in detail the procedures used to collect and analyze data, the essence of the program is an indication of expected mortality in stands of certain characteristics, stratified according to geographic location. For western Montana/northern Idaho, data analysis showed for Douglas-fir stands of otherwise high-hazard conditions (age over 100 years, average diameter over 16" dbh, and high percentage of Douglas-fir in the stand) where Douglas-fir basal area was **115 square feet per acre or less, there was a "low" risk** (average 37 sq. ft. BA) of beetle-caused mortality. **Basal areas between 115 and 230 sq. ft. per acre defined "medium" risk** (average 69 sq.ft. BA) mortality, and **greater than 230 BA defined "high" risk**--112 sq.ft./acre mortality or more.

In addition, data analysis allowed the development of a "model" which can be used to approximate beetle-caused mortality in high-hazard stands where Douglas-fir basal area is known. Using the formula: **DF mortality = 13.2 + 0.33(DF basal area)**, anticipated mortality may be calculated if all other factors of age, average Douglas-fir diameter, and proportion of Douglas-fir in the stand are "high hazard."

Beyond this new "tool," which we must caution needs extensive validation, we have not developed a "hazard rating" system for Douglas-fir beetle, per se. We do know, however, what stand conditions are most likely to attract beetles and where beetle-caused mortality will consequently be greatest, once an outbreak begins. These guidelines have been included in previous reports, but are repeated here because of their pertinence.

The greatest benefits in dealing with actual or potential Douglas-fir beetle infestations are derived from efforts aimed at preventing outbreaks rather than suppressing them. To the extent possible, susceptible stands should be identified and conditions altered to make them less so, prior to some type of stand disturbance which may trigger an outbreak. Likewise, disturbances--such as blowdown (other common ones are defoliation, drought, and fire damage)--should be ameliorated as quickly as possible. In that way, beetle-caused mortality may not exceed acceptable levels. While the following does not constitute a detailed hazard-rating system, it does define what we know about stand conditions which have proven to be most conducive to beetle depredations, once outbreaks are generated. Those conditions are:

1. Stands in which Douglas-fir is the predominant species and sites on which those stands are most commonly found. The higher the percentage of Douglas-fir in the stand--particularly in excess of 50-60 per cent--the greater the susceptibility. Douglas-fir habitat types on south-facing slopes and drier ridges sustain more beetle-caused mortality than other types.

2. Age of Douglas-fir in the stand. As Douglas-fir reaches maturity--and becomes overmature--it slows in growth and is more susceptible to the beetle. Greater than 80 years is considered to be highly susceptible. Beyond 120 years becomes extreme.

3. Size of Douglas-fir in the stand. Usually associated with age, stand susceptibility is also reflected in the size of host trees. Generally, the larger trees in the stand are the more susceptible. Trees less than 14 inches dbh are not as likely to be attacked successfully.

4. Overall stand density. When stocking exceeds 80 percent of "normal" stocking for the site, susceptibility to attack increases significantly. The denser the stocking, which increases between-tree competition and also provides cooler, more shaded environments preferred by the beetle, the greater the probability of infestation. As a rule of thumb, as stocking exceeds 150 square feet of basal area, susceptibility to the beetle correspondingly increases.

Management activities which alter one or more of those stand conditions--species and/or size composition, age, or stocking--can correspondingly reduce susceptibility to Douglas-fir beetle. Where infestations occur, it is usually desirable to salvage and trees. It would be of even greater benefit to reduce stand susceptibility through sanitation thinning as those stands are entered. Where management objectives and other resource considerations permit, removing the larger, older component from susceptible stands will significantly reduce future mortality in those and adjacent, stands.

On all sites, root disease presence or potential should be assessed. On some, particularly ones in northern Idaho and portions of western Montana, abnormally high amounts of root disease have resulted in high "endemic" populations of beetle. In those stands, disturbances are even more likely to result in significant beetle "outbreaks." In addition, where root diseases are present or suspected, partial cutting may result in such a proliferation of root pathogens that unacceptable amounts of mortality occur in leave trees, and will cause a long term increase in the biomass of the root disease fungi.

Even in stands where root diseases may not be readily apparent, we know they are common in Douglas-fir and mixed-species stands in much of northwest Montanta. In many stands, they should probably at least be suspected. Many such stands are candidates for seed-tree or shelterwood harvests followed by underburning as a means of site preparation to enhance regeneration efforts. Frequently, whether or not root diseases are present, fire damage results in enough weakening of residual trees to attract bark beetles. Even in a thick-barked species such as Douglas-fir, bark on large lateral roots just below the duff is relatively thin and easily damaged if fire is "too hot" or prolonged. Such damage is sufficient to essentially girdle trees, which then become an attractant source for beetles. Cathy Stewart, silviculturist, Stevensville RD, studied such a phenomenon on the Clearwater NF about 10 years ago. She concluded that seed trees, underburned, often succumb to a combination of undetected root disease, bark beetle activity, and/or subsurface root damage (personal communication). This is not to suggest underburning should never be done where Douglas-fir is left; but if it is done, the risks need to be recognized. Efforts to protect Douglas-fir leave trees may be beneficial.

Conclusion

We hope these guidelines and general suggestions will be helpful in developing management alternatives which will help reduce beetle-caused mortality to acceptable levels and/or help restore a more healthy and vigorous condition in these currently affected stands. Recognizing that often there are many resource considerations in a particular stand and that addressing all of them may not be feasible, it is our intent only to assess current conditions and strive to portray what may occur in those areas relative to varying management activities or decisions.

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Route To:

Subject: Service Visit--Three Rivers, Libby, and Fortine RDs

To: Forest Supervisor, Kootenai NF

During the period October 22-28, Blakey Lockman and Ken Gibson met with individuals, or groups from Three Rivers, Libby, and Fortine Ranger Districts. They had been asked to assist in determining incidence, or levels, of root diseases and bark beetles in stands for which management is being contemplated. Because stand conditions and observed pests are similar for the several areas, it seemed prudent to address them in a single report. The enclosed trip report describes the unique characteristics of each area, and the groups' observations. Following are conditions, prognoses, and recommendations addressed in a more general sense--appropriate because of their applicability from area to area.

I hope this information is helpful to you and those working on these areas at the project level. If we can be of further assistance, or provide additional information, please contact us.

/s/ Gregg DeNitto

(for)
WILLIAM W. BOETTCHER
Director
State and Private Forestry

Enclosure

cc:
Steve Prieve and Russ Gautreaux; Three Rivers RD
Deena Shotzberger, Anne Weber, and Bruce Higgins; Libby RD
Rob Carlin, Joleen Dunham, and Scott Bates; Fortine RD
Pat Flanary, Rexford RD
Gary Dickerson, Kootenai NF

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Obviously, one of those alternatives may be to "do nothing." So long as there is an awareness of the consequences of that action, in view of prevailing stand conditions to include insects and pathogens; and the decision is made to accept those consequences, it is not our place to second-guess such a decision.

As whichever decisions are made, if we can be of further assistance, or provide additional information, please feel free to contact us. One of the things we discussed was the use of pheromone tree baits and/or funnel traps--useful in some situations to contain beetle populations in already-infested stands, or ones about to be entered, to our advantage. We will gladly provide information relative to their purchase and application if their use is deemed appropriate.

/s/ Blakey Lockman
BLAKEY LOCKMAN
Plant Pathologist

/s/ Ken Gibson
KENNETH E. GIBSON
Entomologist

Reference:

Hagle, S., J.Byler, S.Jeheber-Matthews, R.Barth, J.Stock, B.Hansen, and C.Hubbard. 1994. Root Disease in the Coeur d'Alene River Basin: An Assessment. IN: Symposium Proc. of Interior Cedar-Hemlock-White Pine Forests: Ecology and Management. March 2-4, 1993, Spokane, Washington.